THIRD AXIS INPUT DEVICE FOR MOUSE

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates generally to a mouse for data input and, more specifically, to a third axis input device for a mouse, which combines the parts of a mechanical encoding module and a wheel to form a single module.

2. Description of the Related Art

A conventional mouse comprises an X-axis encoder and a Y-axis encoder for output serial logic signals (for example, 11,10,00,01). Moving the mouse on a flat surface in a specific direction causes relative movement of the data to be processed on the screen of the monitor. Basically, using the mouse to move the position of the data on the screen causes the X-axis encoder and the Y-axis encoder to produce a spot displacement on a plane.

Further, some mice have a third axis input device adapted to control web page scrolling. FIGS. 1-3 show a third axis input device according to the prior art. As illustrated, the third axis input device **60** comprises a hollow wheel holder **61** provided at the bottom board **81** inside the mouse **80**, and an encoder module fastened pivotally with the wheel holder **61**. The encoder module comprises a plastic wheel **70** with a roller **62** fastened to the hollow center of the plastic wheel **70**. The roller **62** has a receiving chamber **63** in one side with a cover shell **67** covering the receiving chamber **63**. The cover shell **67** has a retaining flange **68** fastened to the wheel holder **61**. A barrel **64** is fixedly mounted in the receiving chamber **63**, the barrel **64** having transverse light-guide teeth **65** arranged in parallel around the periphery. A circuit board

66 is fastened to the cover shell 67 and disposed inside the receiving chamber 63, and an infrared transceiver unit 69 is installed in the circuit board 66. The infrared transceiver unit 69 comprises an infrared transmitter 691 adapted to emit infrared light onto the inside wall of the barrel 64. An infrared receiver 692 is adapted to receive infrared light emitted from the infrared transmitter 691 and is guided by the transverse light-guide teeth 65 and to further produce different serial phase signals.

According to the aforesaid third axis input device 60, the barrel 64 is rotated with the roller 62 to encode infrared light into serial phase signals. This design is functional; however, because the third axis input device 60 is comprised of a number of parts, its manufacturing cost is high.

FIG. 4 shows another design of third axis input device for mouse. According to this design, the third axis input device comprises a wheel holder 90 mounted on the bottom board 81 of the mouse 80, a wheel 91 pivoted to the wheel holder 90, and a mechanical encoder module 93 provided at one end of the wheel shaft 92 of the wheel 91. The manufacturing cost of this design of third axis input device is relatively lower than the third axis input device shown in FIGS. 1-3. However, because the wheel 91 and the mechanical encoder module 93 must be separately prepared and installed, this design of third axis input device requires a relatively longer manufacturing time.

Therefore, it is desirable to provide a third axis input device that eliminates the drawbacks of the aforesaid prior art designs.

SUMMARY OF THE INVENTION

The present invention has been accomplished under the circumstances in view. The main object of the present invention is to provide a third axis input

device that is easy to operate and inexpensive to manufacture. Another object of the present invention to provide a third axis input device that combines the parts of a mechanical encoding module and a wheel to form a single module.

According to one embodiment of the present invention, the third input device is used in a mouse and comprises a wheel holder mounted on a bottom board inside the mouse and a roller. The roller has a closed outer side, an inner side, and a receiving open chamber in the inner side. An encoding wheel is mounted inside the roller and pivoted with the roller to the wheel holder, the encoding wheel having a mechanical tooth form. A locating plate is coupled to the inner side of the roller for enabling the roller to be pivoted with the encoding wheel to the wheel holder, the locating plate holding a plurality of probes respectively disposed in contact with the tooth form of the encoding wheel and adapted to output a signal indicative of direction and amount of rotation of the encoding wheel and the roller. The encoding wheel has radial teeth equiangularly spaced around the periphery, and peripheral notches equiangularly spaced around the periphery and equally separated from one another by the radial teeth. The probes can be metal springs or metal conductor members.

According to an alternate form of the present invention, the third axis input device comprises a wheel holder mounted on a bottom board inside the mouse and a roller, the roller having an outer closed side and a receiving open chamber in an inner side thereof. At least one probe wheel has a plurality of probes. A locating plate is coupled to the inner side of the roller to pivot the roller and the at least one probe wheel to the wheel holder, the locating plate holding a fixed encoding wheel in contact with the probes of the probe wheel for outputting a signal indicated of the direction and amount of rotation of the

roller and the at least one probe wheel relative to the wheel holder.

BRIEF DESCRIPTION OF THE DRAWINGS

The foregoing aspects and many of the attendant advantages of this invention will be more readily appreciated as the same becomes better understood by reference to the following detailed description, when taken in conjunction with the accompanying drawings, wherein:

FIG. 1 illustrates a third axis input device installed in the bottom board of a mouse according to the prior art;

FIG. 2 is an exploded view of the third axis input device shown in FIG. 1;

FIG. 3 is a cross-sectional view of the third axis input device shown in FIG. 1;

FIG. 4 is a schematic top view showing another design of the third axis input device installed in the bottom board of a mouse according to the prior art;

FIG. 5 illustrates a third axis input device installed in the bottom board of a mouse according to the first embodiment of the present invention;

FIG. 6 is an exploded view of the third axis input device according to the first embodiment of the present invention;

FIG. 7 is a cross-sectional top plain view of the third axis input device according to the first embodiment of the present invention;

FIG. 8 is a schematic drawing showing the action of the encoding wheel of the mechanical encoder module of the third axis input device according to the first embodiment of the present invention (I);

FIG. 9 is a schematic drawing showing the action of the encoding wheel of the mechanical encoder module of the third axis input device according to the first embodiment of the present invention (II);

FIG. 10 is a schematic drawing showing the action of the encoding wheel of the mechanical encoder module of the third axis input device according to the first embodiment of the present invention (III);

FIG. 11 is a schematic drawing showing the action of the encoding wheel of the mechanical encoder module of the third axis input device according to the first embodiment of the present invention (IV);

FIG. 12 is a schematic drawing showing the action of the encoding wheel of the mechanical encoder module of a third axis input device according to the second embodiment of the present invention (I);

FIG. 13 is a schematic drawing showing the action of the encoding wheel of the mechanical encoder module of a third axis input device according to the second embodiment of the present invention (II);

FIG. 14 is a schematic drawing showing the action of the encoding wheel of the mechanical encoder module of a third axis input device according to the second embodiment of the present invention (III);

FIG. 15 is a schematic drawing showing the action of the encoding wheel of the mechanical encoder module of a third axis input device according to the second embodiment of the present invention (IV); and

FIG. 16 is an exploded view of the third axis input device according to the third embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

Referring to FIGS. 5-7, a third axis input device in accordance with the first embodiment of the present invention is shown installed in a mouse **10**. The third axis input device comprises a wheel holder **1**, a roller **2**, an encoding wheel **3**, a locating plate **4**, two probes **5**, and a spring member **6**.

The wheel holder 1 is a hollow casing provided at the bottom board of the mouse 10, having a through hole 11 and two slots 12 and 12' at two sides of the through hole 11.

The flat roller 2 is rotatably mounted in the through hole 11. The outer side of the roller 2 is a closed side. The closed side of the roller 2 is provided with a center axle hole 22 and three pins 23. The three pins 23 are perpendicularly extending from the inner surface of the closed side of the roller 2, and equiangularly spaced around the axle hole 22. The inner side of the roller 2 is provided with a receiving open chamber 21.

The encoding wheel 3 is disposed inside the receiving open chamber 21, having a flat circular wheel body 33, a center through hole 31 extending through the center of the flat circular wheel body 33 and aimed at the center axle hole 22 of the roller 2, and three pin holes 32 extending through the flat circular wheel body 33 around the center through hole 31 and respectively press-fitted onto the pins 23 of the roller 2, a plurality of radial teeth 34 equiangularly spaced around the periphery of the flat circular wheel body 33, and a plurality of peripheral notches 35 equiangularly spaced around the periphery of the flat circular wheel body 33 and equally separated from one another by the radial teeth 34.

The locating plate 4 comprises a protruding mounting portion 44 projecting from the center of the outer side thereof and fastened to one slot 12 of the wheel holder 1, a partition flange 41 disposed at the inner side thereof, two locating pins 42 and 42' provided at two sides of the partition flange 41, an axle 43 perpendicularly extending from the center of the inner side and inserted through the center through hole 31 of the encoding wheel 3 into the center axle

hole 22 of the roller 2 and then the other slot 12. The spring member 6 is sleeved onto the axle 43 and stopped between the flat circular wheel body 33 of the encoding wheel 3 and the locating plate 4. Therefore, the locating plate 4 and the roller 2 are pivoted to the slots 12 and 12' of the wheel holder 1, and the second spring member 6 is maintained in contact with the encoding wheel 3.

The spring member 6 is a common pole metal spring member. The probes 5 and 5' can be metal spring strips or metal torsional springs. According to this embodiment, the probes 5 and 5' are metal torsional springs respectively mounted on the locating pins 42 and 42' of the locating plate 4, each having a front contact end 51 or 51' disposed in contact with the periphery of the encoding wheel 3.

When receiving electricity from the spring member 6, the rotary motion of the roller 2 is caused to rotate. During rotary motion of the roller 2, the front contact ends 51 and 51' of the probes 5 and 5' are continuously alternatively touching the radial teeth 34 or peripheral notches 35 of the encoding wheel 3 to produce signals subject to the following conditions:

When the front contact ends 51 and 51' of the probes 5 and 5' commonly touch the radial teeth 34, an output signal (1,1) is produced as shown in FIG. 8.

When the front contact ends 51 and 51' of the probes 5 and 5' respectively touch one peripheral notch 35 and one radial tooth 34, an output signal (0,1) is produced as shown in FIG. 9.

When the front contact ends 51 and 51' of the probes 5 and 5' commonly touch the peripheral notches 35, an output signal (0,0) is produced as shown in FIG. 10.

When the front contact ends 51 and 51' of the probes 5 and 5' respectively touch one radial tooth 34 and one peripheral notch 35, an output signal (1,0) is produced as shown in FIG. 11.

During clockwise rotation of the roller 2, the third axis input device outputs the aforesaid four signals repeatedly in proper order. During counter-clockwise rotation of the roller 2, the third axis input device outputs the aforesaid four digital signals repeatedly in the reversed order. Therefore, the posterior circuit of the mouse gives a signal to the computer indicative of the angle and amount of movement of the roller 2.

Alternatively, the probes 5 and 5' can be arranged to output signals (1,1), (1,0), and (0,0).

FIGS. 12-14 are schematic drawings showing the action of the encoding wheel of the mechanical encoder module of a third axis input device according to the second embodiment of the present invention. According to this embodiment, the probes 72 and 73 are metal spring strips. When the roller 2 receives electricity from the metal conductor member 71 and starts to rotate, the probes 72 and 73 are forced to continuously and alternatingly touch the radial teeth 34 or peripheral notches 35 of the encoding wheel 3 and to further produce signals subject to the following conditions:

When the probes 72 and 73 commonly touch the radial teeth 34, an output signal (1,1) is produced as shown in FIG. 12.

When the probes 72 and 73 respectively touch one peripheral notch 35 and one radial tooth 34, an output signal (0,1) is produced as shown in FIG. 13.

When the probes 72 and 73 commonly touch the peripheral notches 35, an output signal (0,0) is produced as shown in FIG. 14.

When the probes 72 and 73 respectively touch one radial tooth 34 and one peripheral notch 35, an output signal (1,0) is produced as shown in FIG. 15.

Alternatively, the probes 72 and 73 can be arranged to output signals (1,1), (1,0), and (0,0).

FIG. 16 is an exploded view of the third axis input device according to the third embodiment of the present invention. According to this embodiment, the third axis input device is mounted inside a mouse 10, comprising a wheel holder 1, a flat roller 2, a probe wheel 8 mounted in the receiving open chamber 21 of the roller 2 and holding three equiangularly spaced probes 81, 82, and 83 at one side, an encoding circuit board 9, and a cover plate 94 fastened to the roller 2 to hold the encoding circuit board 9 inside the receiving open chamber 21 in contact with the probes 81, 82, and 83. The roller 2, the probe wheel 8, the encoding circuit board 9 and the cover plate 94 are fastened together and inserted into the through hole 11 and pivoted to the slots 12 and 12' of the wheel holder 1. The encoding circuit board 9 comprises a common contact portion 91, a conducting portion 92, and an electrically insulative portion 93 respectively disposed in contact with the probes 81, 82, and 83. The common contact portion 91 and the conducting portion 92 can be sealed on the surface of the substrate of the encoding circuit board 9 by a press or glue. Alternatively, the common contact portion 91 and the conducting portion 92 can be directly printed on the encoding circuit board 9. During rotary motion of the roller 2, different signals (1,1), (1,0), (0,0), (0,1) are produced subject to the direction and amount of rotation of the roller 2.

Although a particular embodiment of the invention has been described in detail for purposes of illustration, various modifications and enhancements

may be made without departing from the spirit and scope of the invention. Accordingly, the invention is not to be limited except as by the appended claims.